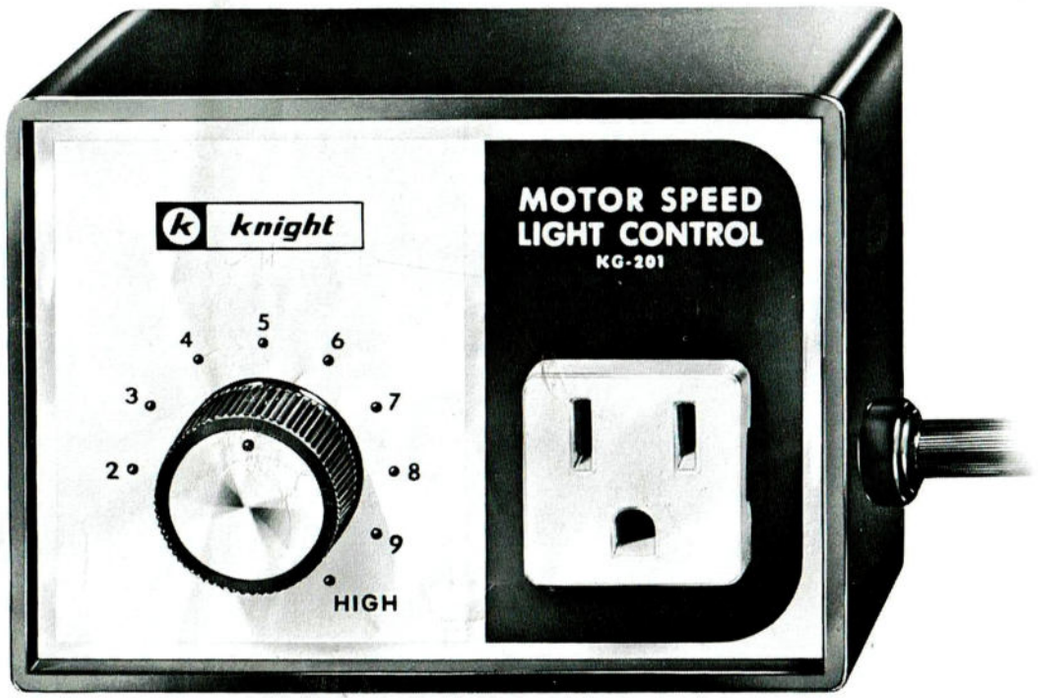
KG-201

MOTOR SPEED LIGHT CONTROL



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THIS KIT MUST BE PROPERLY SOLDERED!

USE ENOUGH HEAT

This is the main idea of good soldering. Apply enough heat to the metal surfaces you are joining to make the solder spread freely, until the contour (shape) of the connection shows under the solder.

AN ELECTRONIC UNIT WILL NOT WORK . . . unless it is properly soldered. Read these instructions carefully to understand the basic ideas of good soldering.

Enough heat must be used so the solder can actually penetrate the metal surfaces, making an unbroken path over which electricity can travel. You are not using enough heat if the solder barely melts and forms a rounded ball of rough, flaky solder.

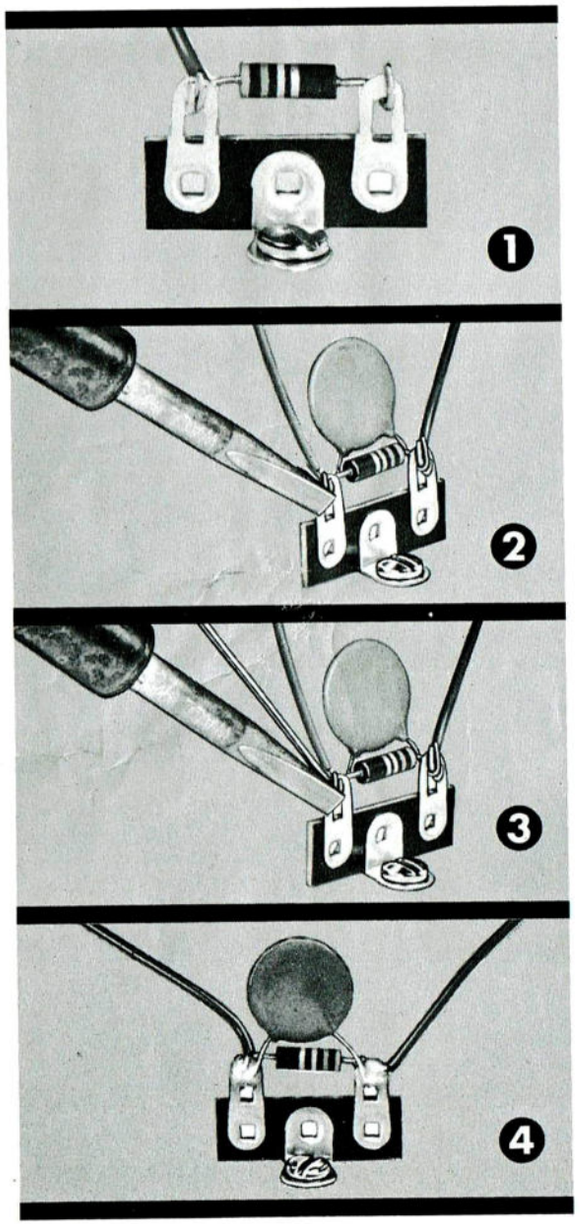
Use the Right Soldering Tool

A soldering iron in the **27-40** watt range is recommended. Any iron in this range with a clean, chisel-shaped tip will supply the correct amount of heat to make a good solder connection. You may also use a solder gun but make sure the tip reaches full heat before you solder.

Keep the iron or gun tip brightly coated with solder. When necessary, wipe the hot tip clean with a cloth. If you are using an old tip, clean it before you start soldering.

Use Only Rosin Core Solder

We supply the right kind of solder (*rosin core solder*). Do not use any other kind of solder! **Use of Acid Core Solder, Paste, or Irons Cleaned on a Sal Ammoniac Block will ruin any Electronic Unit and will Void the Guarantee.**



HERE'S HOW TO DO IT . . .

1. Join bare metal to bare metal; insulation must be removed. Make good mechanical connections and keep resistor and capacitor leads as short as possible, unless otherwise specified.

2. Coat the tip of a hot iron with solder. Then **Firmly Press the Flat Side of the Tip** against the parts to be soldered together. Keep the iron there while you . . .

3. Apply the solder between the metal to be soldered and the iron tip. Use only enough solder to flow over all surfaces of the connection, and all wires in the connection. Remove the iron.

Do Not Move Parts Until the Solder Hardens. If you accidentally move the wires as the solder is hardening, apply your iron and reheat.

4. Compare your soldering with the pictures on this page. You have a good connection if your solder has flowed over all surfaces to be connected, following the shape of the surfaces. It should appear smooth and bright and all wires in the connection should be well-soldered.

You Have Not Used Enough Heat: If your connection is rough and flaky-looki[illegible] the solder has formed a round ball instead of spreading.

The difference between good soldering (enough heat) and poor soldering (not enough heat) is just a few extra seconds with a hot iron **firmly** applied. REMEMBER, LARGER METAL SURFACES TAKE A LONGER TIME TO HEAT.

UNPACKING

This is an important step because it gives you a chance to become familiar with the parts of your kit.

☐ Carefully unpack the parts. Be careful not to damage any delicate parts. DO NOT bend the leads of the SCR.

☐ Check the contents of your kit against the PARTS LIST. Refer to the wiring diagrams, to identify any part that you are not familiar with.

☐ Assort hardware by size. Two sizes are used in your kit. #4 hardware is smaller than #6.

☐ Refer to the soldering instructions on page 2. Read and understand them thoroughly, before attempting any soldering.

Take your time, and work slowly — we know that you will enjoy building this kit, and are sure you will be pleased with the completed unit.

MOUNTING PARTS ON THE SCR BRACKET

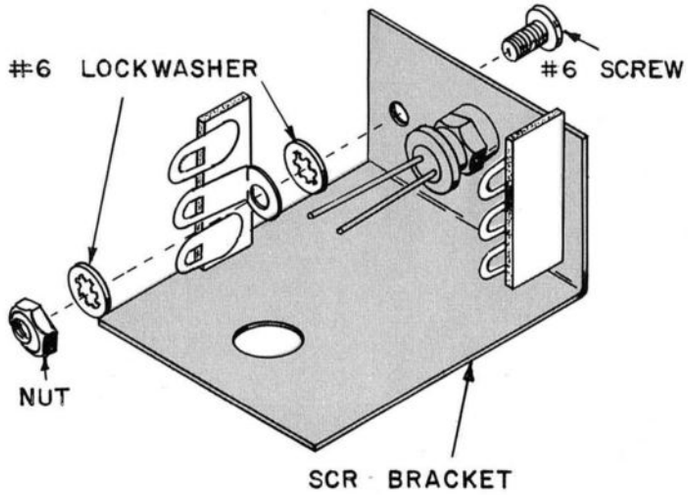


FIGURE 1.

SEE FIGURE 1.

CAUTION: Do not tighten the SCR mounting nut. This nut has been tightened to a specific torque value at the factory; additional tightening will cause permanent damage.

Mount two terminal strips on the bracket in the following manner:

☑ Insert two #6 screws through the small holes in the bracket, as shown.

☑ Place a #6 lockwasher over the threaded portion of each screw.

☑ Position the terminal strips on the screws, as shown, and fasten each with another #6 lockwasher and nut. Tighten securely; the terminal strips must make firm electrical contact with the bracket.

PREWIRING THE SCR BRACKET

SEE FIGURE 2.

CAUTION: Do not bend the SCR leads sharply at the point where they are connected to the case. Sharp bending here may break the sealing of the unit, and result in permanent damage.

IMPORTANT INSTRUCTIONS

THE INSTRUCTION CONNECT MEANS: Connect the wire or lead to the given point. Make a firm mechanical connection, BUT DO NOT SOLDER AT THIS TIME. Later, other wires or components will be connected to this same point.

THE INSTRUCTION SOLDER MEANS: Connect the wire or lead to the given point and then solder the connection, and all wires in it. If there is more than one wire in the connection, the number of wires will be stated — for example (2 wires). After soldering, trim all excess wire, as close as possible to the terminal.

NOTE: Unless told to do otherwise, make all connections to the terminal strip lugs. DO NOT block the round holes at the bases of the terminal lugs. Additional wires will be soldered into these holes.

- ☐ G lead (shorter lead) from SCR. Connect to terminal 1 of TS-2.
- ☐ CR-1, silicon diode. One end of this diode will be tapered, or banded; this is the marked end. Cut a ½″ piece of tubing from the length supplied and slip it over the lead from the UNMARKED end. Connect this lead to terminal 3 of TS-2. Connect the lead from the marked end to terminal 3 of TS-1.
- ☐ Circuit breaker. Slip ½″ of tubing over each lead. Solder one lead to terminal 3 of TS-1 (2 wires). Solder the other lead to terminal 1 of TS-1.
- ☐ C-1, 50 μf electrolytic capacitor. Slip 2″ of tubing over the lead from the end marked + (plus). Bend the end of the lead over the tubing, to keep it from falling off. Cut the lead from the other end to ½″ and connect it to terminal 3 of TS-2.

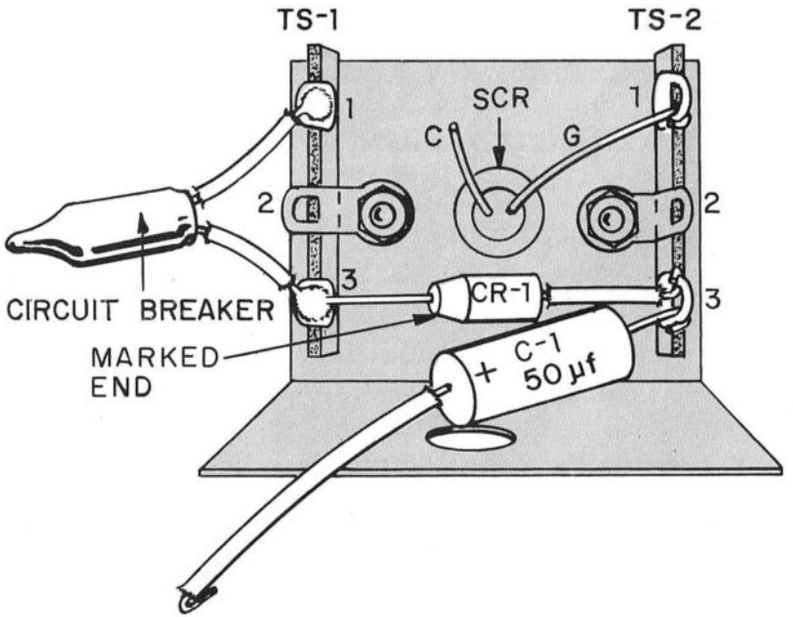


FIGURE 2.

ASSEMBLY

SEE FIGURE 3.

- [x] R-2, 500Ω control, and shouldered fiber washer. Place the washer over the threaded portion of the control, with the shoulder facing the end of the shaft.
- [x] Insert the control through the large hole in the SCR bracket. Be sure that the shoulder washer is seated in the hole; the control must not touch the bracket.
- [x] Flat fiber washer. Place over the control shaft.
- [x] Fiber insulator. Slip over the control, and align with the SCR bracket.
- [ ] Front panel. Place over the control, with the stenciled side facing away from the bracket. Thread the large nut onto the control, position all of the components as shown in the figure, and tighten the nut.

CAUTION: Be sure that the SCR bracket **DOES NOT** touch the front panel, or make ANY electrical contact with it.

- [ ] Three-wire receptacle. Position the green lead close to the edge of the panel, as shown. Snap the receptacle into the front panel, from the stenciled side.

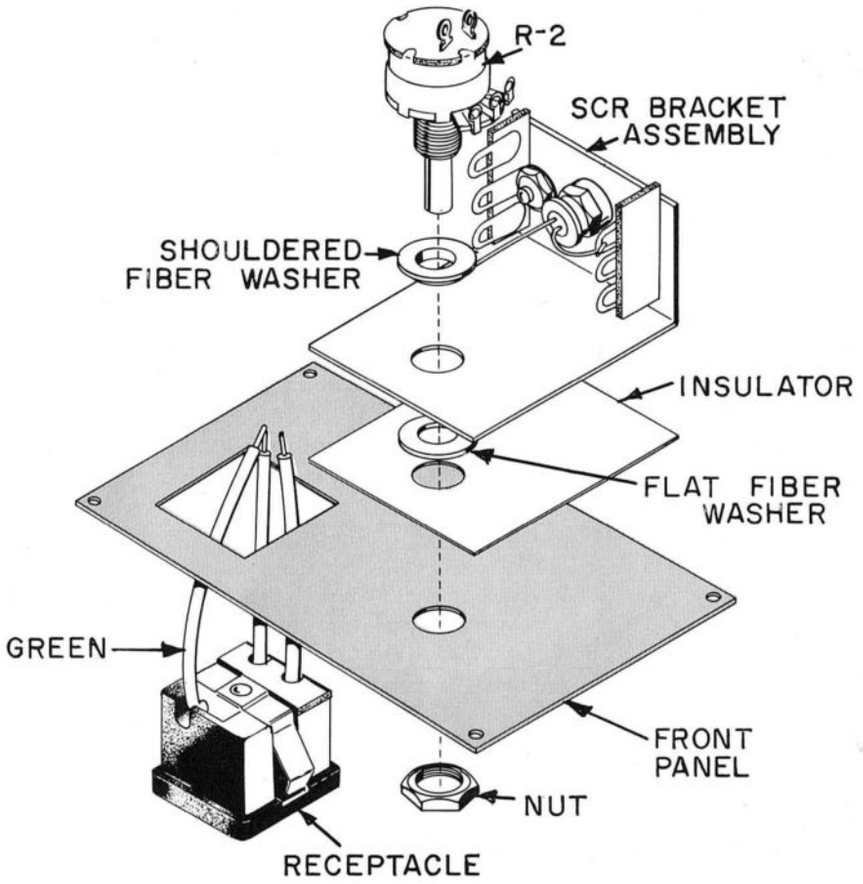


FIGURE 3.

FIRST WIRING

SEE FIGURE 4.

- [ ] Linecord. Slip the free end through the hole in the case, from the outside.

- [ ] Twist the strands from the green linecord and green receptacle leads together, in a clockwise direction.

- [ ] Wire connector. Tighten onto the joint of the two green wires. Be sure that no wire strands extend from the bottom of the connector, and that no bare wire remains visible after the connector is tightened.

NOTE: Before connecting the leads from the receptacle and linecord, twist the wire strands together and lightly coat with solder. DO NOT solder coat the white receptacle lead, until told to do so.

Solder the following leads into the holes at the base of the terminal strip lugs, as shown in Detail A. Cut the wire ends to ¼" before connecting.

- [ ] Black lead from receptacle. Solder to terminal 3 of TS-1.

- [ ] White *linecord lead*. Solder to terminal 2 of TS-1.

- [ ] Black linecord lead. Solder to terminal 1 of TS-1.

- [ ] Unconnected lead from C-1. Route around the control, and connect to terminal 5.

- [ ] R-1, 2500 Ω 7-watt resistor. Slip ¾" of tubing over one lead and connect to terminal 2 of TS-1. Slip 1¼" of tubing over the other lead and solder to terminal 5 of the control (2 wires).

- [ ] R-3, 10 Ω resistor (brown, black, black). Solder one lead to terminal 3 of TS-2 (3 wires). Solder the other lead to terminal 3 of the control.

- [ ] C lead from SCR. Slip ¾" tubing over the lead and connect to terminal 1 of the control. Do not block the terminal opening; other wires will be added later.

- [ ] Red wire. Solder one end to terminal 2 of TS-1 (2 wires). Solder the other end to terminal 2 of the control.

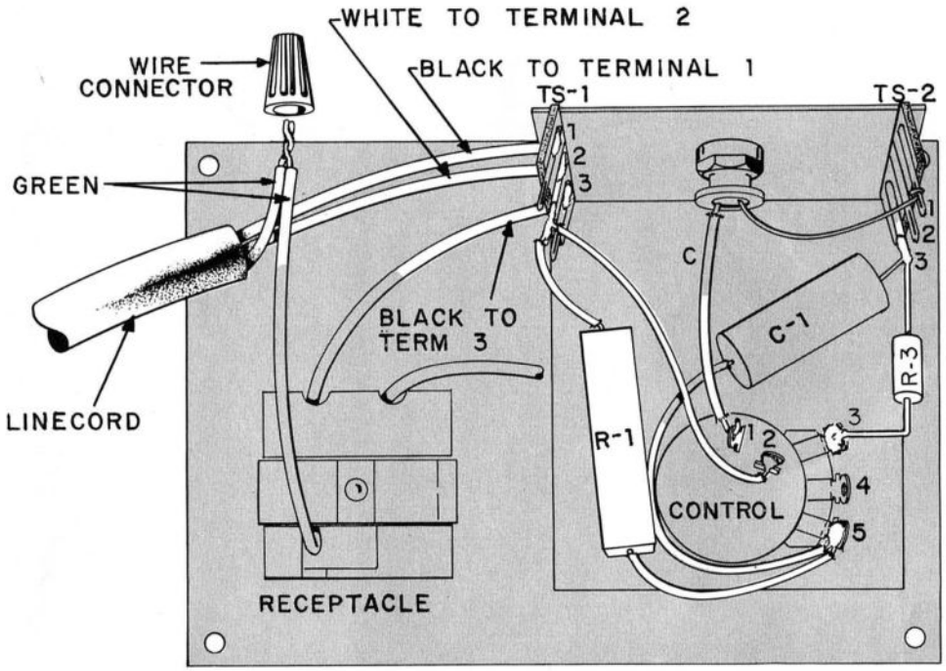
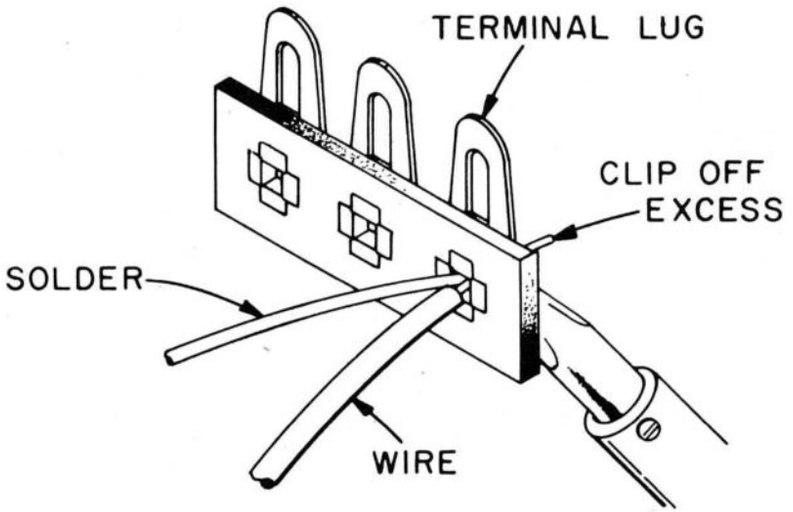


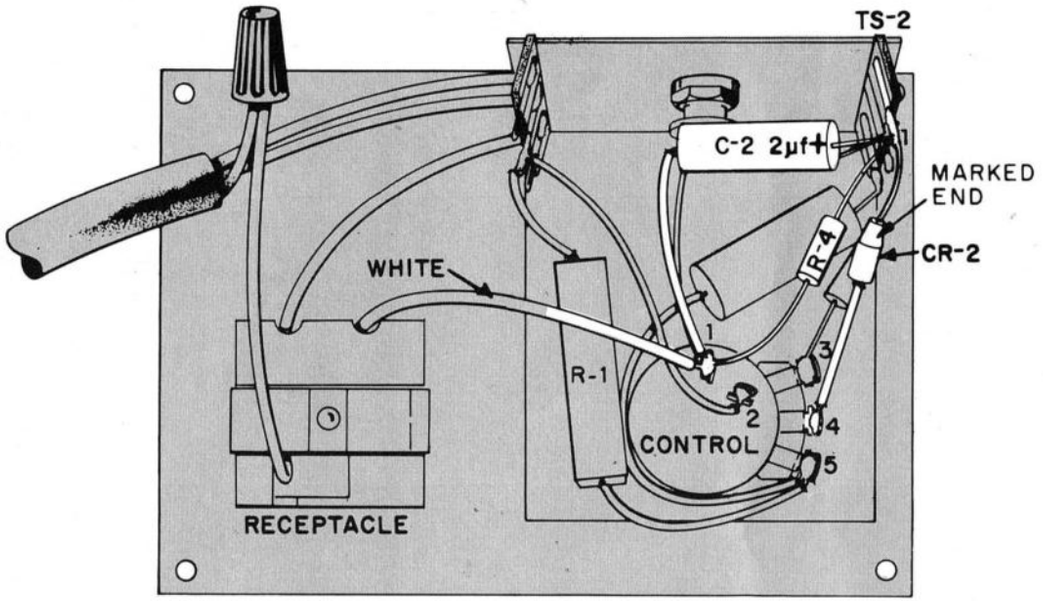
FIGURE 4.

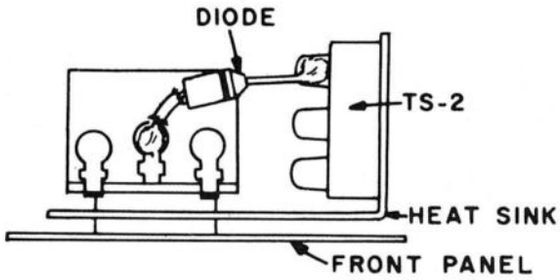


DETAIL A.

FINAL WIRING

FIGURE 5.





DETAIL A.

SEE FIGURE 5.

☑ CR-2, silicon diode. Slip ⅜″ of tubing over the lead from the unmarked end and solder to terminal 4 of the control. Connect the other (marked) lead to terminal 1 of TS-2.

☑ R-4, 150 Ω resistor (brown, green, brown). Connect one lead to terminal 1 of TS-2. Connect the other lead to terminal 1 of the control.

☑ C-2, 2 μf electrolytic capacitor. Cut the + (plus) lead to ½″ long and solder to terminal 1 of TS-2 (4 wires). Slip ¾″ of tubing over the other lead and connect to terminal 1 of the control.

☑ White lead from receptacle. Clip 10 strands from this lead, twist the remaining strands together and coat lightly with solder. Solder this lead to terminal 1 of the control (4 wires).

☑ Press the circuit breaker flat against the large resistor, R-1. The circuit breaker must be as close as possible to the resistor, to assure maximum circuit protection.

— CAUTION —

DO NOT plug the linecord into an outlet until the wiring has been checked and—THE UNIT INSTALLED IN THE CASE.

INSPECTION

☐ Check positioning of all parts; they must not extend above TS-2, as shown in DETAIL A.

☑ Go back and recheck all of the wiring. Be sure that solder has not flowed down terminals, and shorted to the SCR bracket.

☑ Check terminal 2 of TS-2. This terminal should have no wires connected to it.

☑ Check, to be sure that there is NO electrical connection between the SCR bracket and front panel. Serious electrical shock may result if the front panel is shorted to the SCR bracket.

☑ Check your soldering. Reheat any doubtful connection, and add a small amount of solder.

FINAL ASSEMBLY

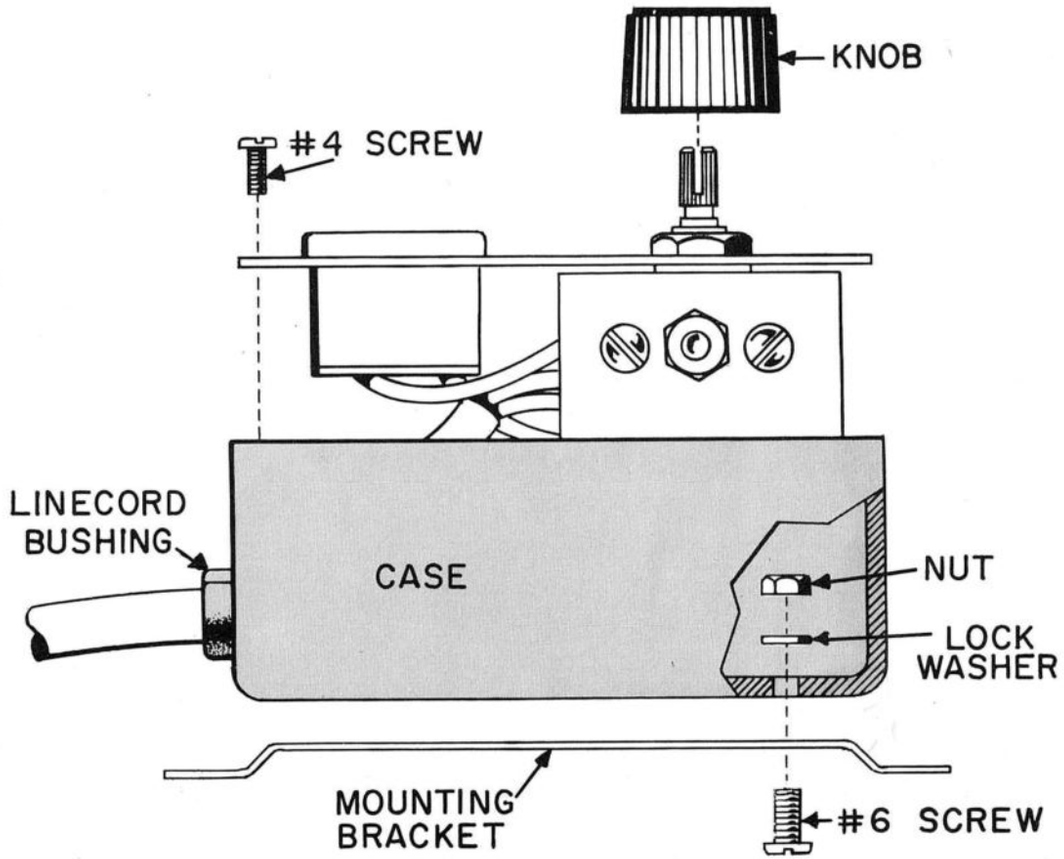
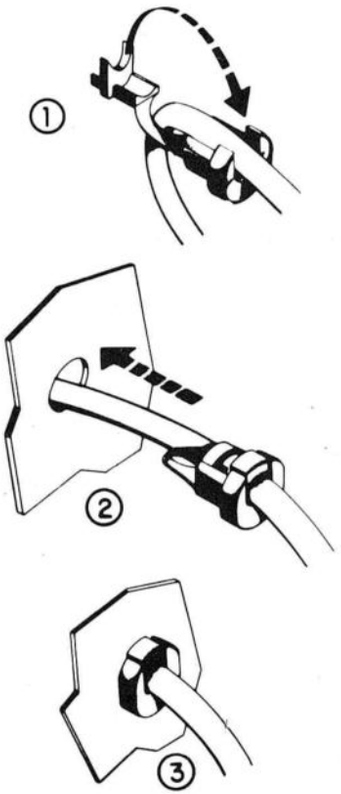


FIGURE 6.



DETAIL A

SEE FIGURE 6.

NOTE: The mounting bracket may be omitted, if you do not intend to permanently fasten the unit to a workbench etc.

☑ Mounting bracket. Fasten to the bottom of the case with two #6 screws, lockwashers and nuts. Insert the screws through the bracket, and into the case, so that their heads will be on the outside.

☑ Large insulator. Slip down into the case, so that the mounting bracket hardware is covered.

☑ Position the front panel assembly in the case, as shown. Fasten with four #4 screws. Do not overtighten the screws.

☑ Turn the shaft of the control fully clockwise, until a click is heard.

☑ Knob. Align the dot on the knob with the HIGH marking on the panel. Slide the knob onto the control shaft, as far as it will go, and tighten the setscrew.

☐ Linecord bushing. Compress on the linecord, and snap into the case, as shown in Detail A.

TESTING THE UNIT

- [ ] Plug an incandescent lamp into the receptacle. Any incandescent lamp of 500 watts or less will do.
- [ ] Turn the control fully counter-clockwise.
- [ ] Plug the speed control linecord into an outlet.
- [ ] Turn the lamp (or other unit used for the test) on. The lamp should NOT light. If the lamp lights to full brilliance, IMMEDIATELY unplug the speed control linecord and recheck your wiring for errors.
- [ ] If the lamp did not light, rotate the control. The lamp should light, dimly at first, and get brighter as the control is turned.

NOTE: Some "dead" area will normally appear as the control is turned. This area is normal, and is required for the unit to control large loads.

- [ ] Disconnect the lamp and connect a universal motor. A small hand tool, such as an electric drill or sabre saw, will serve best.
- [ ] Turn on the tool and rotate the control. The motor speed should vary from full speed, with the control at maximum clockwise, to stopped.

NOTE: Hunting (pulsing) at some slow and intermediate speeds is normal, with no load applied to the motor. When a load is applied, hunting will cease, and smooth power will be delivered.

OPERATING INSTRUCTIONS

The Knight speed controller is designed to help the user of portable electric hand tools. The unit will control the speed of any universal or series wound (brush type) motor. Almost all hand tools use this type of motor.

Controlling the speed of small hand tools will, in many cases, allow the tool to do bigger jobs. A small ¼" electric drill may be slowed to allow it to drill much larger holes without overheating the drill bit. Slowing the speed of a sabre saw will allow it to cut through plastic or metal with ease.

Many uses of this handy speed controller are immediately obvious, but other more subtle uses will be found after using the unit for a while.

— CAUTION —

When operating a tool at reduced speed, be careful that it does not overheat. The fans used for motor cooling are designed to provide maximum cooling at full-speed. Running at reduced speed will reduce the cooling-air flow, and cause the tool to overheat. When a tool becomes too hot to hold comfortably, either turn it off and allow it to cool, or remove the load and run at full speed for a couple of minutes. The cooling fan, running at full speed will quickly cool it.

— ATTENTION —

Do not attempt to operate AC-ONLY equipment with the speed controller. This type of equipment will be permanently damaged by the pulsating DC output. Television sets, radios, and fluorescent lights fall into this classification. Induction motors, such as used on electric fans, washing machines, and other large equipment are also AC-only type and should not be operated with the speed controller. Check equipment manufacturers specifications if there is any doubt as to what type of motor is used.

RESISTIVE LOADS

Soldering irons, light bulbs, heating pads, etc. fall into the class of resistive loads. The speed controller may be used continuously with any resistive load, up to 500-watts; intermittently to 900-watts. Thus, the brilliance of incandescent lights may be varied, from off, to full brightness, and soldering iron temperature may be varied.

Do not use the speed control to power a soldering gun. Soldering guns are transformer operated, and will be damaged.

GENERAL INFORMATION

Unplug the linecord from the power source when not in use. The unit is not equipped with an on-off switch, and will draw a continuous 5-watts, until disconnected from the power source.

NOISE

Radio and television interference may be noticed, when the unit is operated close to the set. This condition is normal, caused by the functioning of the SCR. The amount of interference will vary, depending upon the setting of the control.

CIRCUIT DESCRIPTION

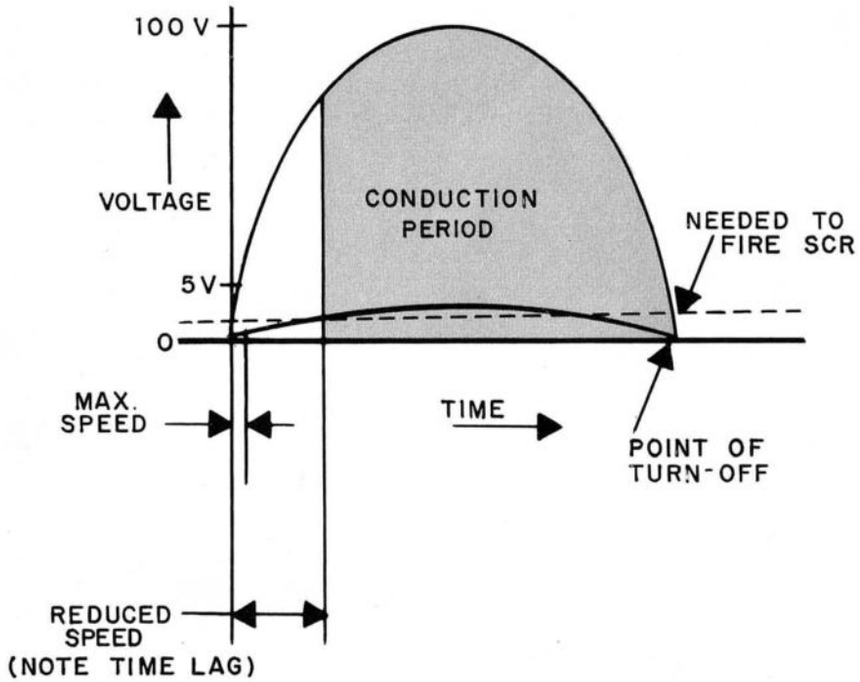
Silicon controlled rectifiers are a recent development of semiconductor technology. Basically the SCR is a silicon diode, or rectifier. This rectifier acts as a valve, and allows current to flow in one direction only, thus changing AC (alternating current) to pulsating direct current. A third element has been added to this particular type of rectifier, for control purposes. This third element is called a gate. With current applied, the SCR will not conduct until a suitable voltage is applied to the gate. When proper bias voltage is applied to the gate, the unit immediately goes into full conduction, and the gate has no further control. Thus, the gate "turns on" the unit. The SCR may not be turned off until the current flow through it is reduced to zero, or the polarity of the supply voltage is reversed. Since the speed controller is connected to a 60 cycle AC source, and performs as a ½ wave rectifier, the SCR is turned off at the 60 cycle rate.

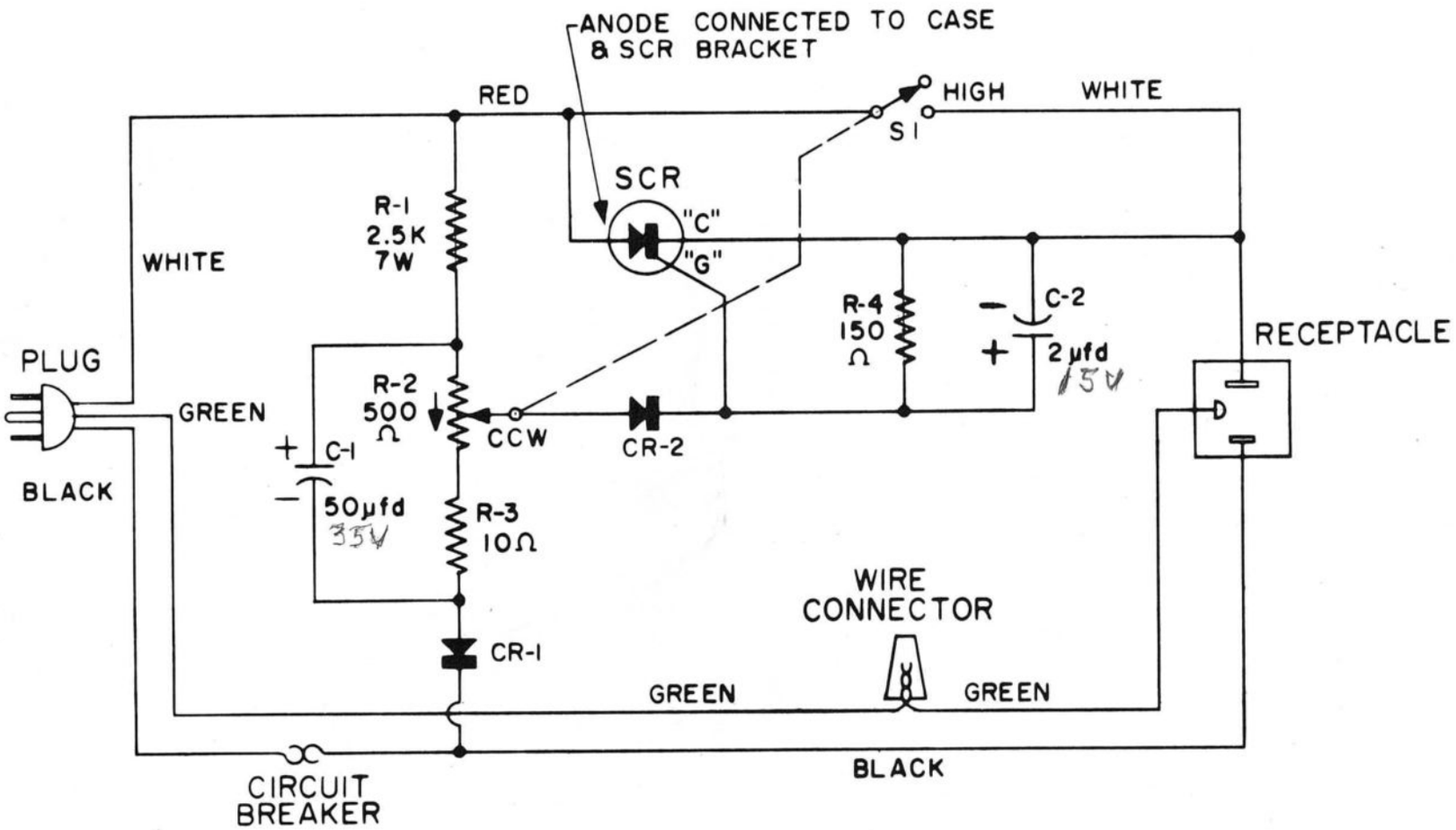
Since the "turn off" point of the SCR is always the same, determined by the 60 cycle AC line, Speed control can only be achieved by delaying the "turn on", or firing, to a later point in the AC cycle. This delayed firing is accomplished by applying a greatly reduced bias voltage to the gate. About 1-volt is needed to fire the SCR. If the bias voltage is reduced to 5-volts, at the peak of the AC cycle, it can be seen that the 1-volt firing point will be delayed, and only about 80% of the DC output pulse will be applied to the motor. It may be concluded that reducing the bias voltage to a lower level, will delay the firing point still further, and decrease motor speed. Increasing bias voltage will fire the SCR earlier and thus increase motor speed.

The great advantage that this type of speed control exhibits, over simple voltage type controls, is the ability of the motor to maintain full power (or torque) at ANY speed. This is obtained by taking advantage of the back EMF (voltage) produced by the motor itself. This back EMF is generated during the ½ cycle that power is not applied and travels back through the linecord, presenting itself at the cathode of the SCR. Back EMF is proportional to motor speed, increasing as speed increases. Gate voltage is opposed or "bucked" by the back EMF. As motor speed increases, back EMF increases to a point where it equals the gate bias voltage. At this point, the motor will run at a constant speed.

If the motor load is increased, the speed, and back EMF will decrease. The gate reference voltage, however, will remain at the same level. This phenomenon causes the gate to fire the SCR earlier, to try to maintain balance with the back EMF. As a result, motor speed and torque remain constant.

At some slow or intermediate speeds, the sensitive circuit used in the speed controller will cause the motor to pulse, or hunt. This condition is normal, and will cease when a load is applied to the motor.





SCHEMATIC DIAGRAM

TROUBLESHOOTING HINTS

	SYMPTOM	POSSIBLE CAUSES
	If the unit does not operate properly, refer to the following chart for possible fault locations.	
1.	Unit is completely dead.	Defective power cord or plug; defective receptacle or cct. brkr.
2.	No change in output when switching between "high" and variable positions.	Shorted SCR (anode to cathode); defective switch.
3.	Output drops when switching from "high" to variable, but no control over range of rotation.	Resistor R-2 open; Diode CR-1 open; Defective control; Defective SCR.
4.	No output in variable position, but full output in "high."	Resistor R-2 open. Diode CR-2 open. Capacitor C-2 or C-1 shorted. Defective control. Defective SCR.
5.	Lamp Brilliance gradually increases.	SCR is heating up excessively; load too heavy; defective SCR.
6.	Lamp flickers badly at almost all intensity settings.	Capacitor C-1 open
7.	Unit operates intermittently with load connected.	Improper load; load too heavy; defective circuit breaker.
8.	Erratic or intermittent operation.	Short circuit between the bottom and center lugs of terminal strip TS-1, or between the bottom lug and heatsink. Screw mounting terminal strip TS-1 not tightened securely. Defective control.
9.	Violent damage to capacitor C2 and Resistor R4 shows signs of over-heating.	(Anode-to-gate) short in SCR
10.	Control element burned-blacking around control lugs 1, 2 and 3 (Resistor R3 probably burned)	Diode CR-1 or CR-2 shorted
12.	Resistor R3 burned	Diode CR-1 or CR-2 shorted

PARTS LIST

CAPACITORS

NOTE: The capacitors supplied with your kit may have a higher votage rating than specified.

Symbol	Part Number
C-1, 50 μf 25V. electrolytic	J209-056
C-2, 2 μf 10V. electrolytic	J225-453

RESISTORS

Symbol	Part Number
R-1, 2.5K 7-watt	J373-006
R-2, 500 Ω ¾-watt control (S-1 attached)	J420-183
R-3, 10 Ω ½-watt	J301-100
R-4, 150 Ω ½-watt	J301-151

DIODES

Symbol	Part Number
CR-1	J630-068
CR-2	J630-068

SILICON CONTROLLED RECTIFIER

Symbol	Part Number
SCR (part of 040-208 assembly)	J630-067

TERMINAL STRIPS

Symbol	Part Number
TS-1, 3-terminal	J440-301
TS-2, 3-terminal	J440-301

MISCELLANEOUS

Description	Quantity	Part Number
Bracket assembly SCR	1	J040-208
Bracket, mounting	1	J470-744
Bracket, SCR (part of 040-208 assembly)	1	J470-743
Bushing, linecord	1	J880-022
Case	1	J702-106
Circuit breaker	1	J195-058
Connector, wire	1	J509-100
Insulator, fiber	1	J850-185
Insulator, large fiber	1	J850-197
Knob	1	J765-074
Linecord	1	J809-144
Lockwasher #6	6	J582-300
Nut #6	4	J570-340
Nut ⅜″	1	J570-840
Panel, front	1	J463-599
Receptacle, 3-wire	1	J509-101
Screw #4	4	J560-223
Screw #6	4	J560-342
Solder	1 Pc.	J930-004
Spacer, SCR (part of 040-208 assy.)	1	J485-097
Tubing	1 Pc.	J812-001
Washer, flat fiber	1	J590-702
Washer, shouldered fiber	1	J595-054
Wire, 2″ red	1	J807-054

FOR SERVICE ON EQUIPMENT

KNIGHT-KIT REPAIR DEPT.
Allied Radio Corporation
100 N. Western Ave.
Chicago, Illinois 60680

FOR TECHNICAL ASSISTANCE AND REPLACEMENT PARTS ORDERS

KNIGHT-KIT TECHNICAL SALES
Allied Radio Corporation
100 N. Western Ave.
Chicago, Illinois 60680

KNIGHT-KIT WARRANTY AND INFORMATION SERVICE

MODEL KG-201 MOTOR SPEED LIGHT CONTROL

PARTS WARRANTY

Every Knight-Kit is fully warranteed, for a period of ninety (90) days from date of purchase, against defects in material and workmanship.

Prompt, no-charge replacement of defective parts will be made. We reserve the right to request the return of any defective part prior to replacement.

Parts which, in our judgment, have been misused or otherwise damaged during construction are not covered by the terms of this warranty.

IN WARRANTY REPAIR SERVICE

Within 90 days from date of shipment you may return your completed Knight-Kit for repair and adjustment for a minimum service and handling charge of $3.50.

Kits not completely wired or which require extensive rework to make them operable, will be subject to a charge for labor at the rate of $7.50 per hour plus the cost of any parts required. You will be notified of the amount of any such extra charge prior to repairing your unit.

Units not constructed in accordance with the assembly instructions, modified in any way, or show evidence of misuse, neglect or accident or indicate that acid core solder has been used will be returned unrepaired at the owner's expense.

OUT OF WARRANTY SERVICE

Allied maintains complete service facilities for all its products. If service is required, follow the instructions given at the right. Repair charges will be for the cost of material, plus $7.00 per hour for service time.

We reserve the privilege of making revisions in current production and assume no obligation to incorporate these changes in earlier models.

The preceding Warranty and Service policy applies only to the original purchaser and is in lieu of all other warranties, expressed or implied. Allied assumes no liability for consequential damages, or other losses incurred by the buyer in connection with the purchase, construction or operation of any Knight-Kit product.

IMPORTANT INSTRUCTIONS

If your unit is not operating properly, first write to our Technical Consulting Service for assistance. Be sure to include:

1. The model number, stock number and the production series number which appear on the chassis and the carton.
2. Date of purchase.
3. An exact description of the difficulty.
4. Everything you have done in trying to correct the difficulty.

Authorization must be obtained before returning your equipment for service. Equipment eligible for return for service under the terms of our warranty must be accompanied with the original invoice or a copy thereof. (Original invoices will be returned to you.)

PACKING AND SHIPPING INSTRUCTIONS

Upon receipt of your return authorization, please pack your equipment in a sturdy shipping carton and tightly cushion it with packing material to avoid costly damage in transit. **The carrier is not responsible for any damage incurred in transit if, in his opinion, inadequate packaging is used.**

Send the package prepaid **and fully insured** to the address listed below.

Mark the package: **Fragile—Delicate Electronic Equipment.**

Repaired equipment will be returned to you prepaid, at your expense.

For Service:

Knight-Kit Repair Dept.
Allied Radio Corp.
100 N. Western Ave.
Chicago, Illinois 60680

For Technical Assistance and Parts:

Knight-Kit Technical Sales
Allied Radio Corp.
100 N. Western Ave.
Chicago, Illinois 60680

KNIGHT-KIT INQUIRY

Stock No. 22-3335-X

Model No. K6-201

Production Run No. 3903-007-J

Should you find it necessary to write us about your kit, please use the space below. If you are ordering a part, be sure to give the complete description and part number as listed in the manual.

We will give your inquiry prompt attention.

LIST PARTS BELOW

Part Number	Quantity	Complete Description	Do Not Write Below		

Date of purchase_____

☐ Remittance enclosed

☐ Ship COD (COD minimum $5.00, and requires 20% deposit)

☐ Add to Credit Fund Account #_____

☐ In-Warranty replacement

MAIL TO:

KNIGHT-KIT TECHNICAL SALES

ALLIED RADIO CORP.

100 N. Western Ave.

Chicago, Ill. 60680

Name_____

Number & Street_____

City_____ State_____

Zip_____

750713